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# CHANGES AND PERSPECTIVES IN AGRICULTURAL LAND-USE AND THEIR GEOECOLOGICAL CONSEQUENCES FOR THE MOUNTAIN OF MALLORCA ISLAND[1]

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*ABSTRACT.- The changes in land-use, caused by the impact of mass tourism which has occured in the Balearics since the 50s, are analyzed in the Serra de Tramuntana of the Mallorca island (Balearic Islands, Spain). The result has been a disarticulation of the traditional territorial organization based on agro-silvo-pastoral activities. New activities are now appearing, related to leisure and recreation, whilst the territorial aptitude of the Serra de Tramuntana, with regard to its geoecological characteristics is basically transformed into a large natural park.*

*RESUMEN.- Se analizan los cambios de uso del suelo en la Serra de Tramuntana de la isla de Mallorca (islas Baleares, España) ocasionados por el impacto del turismo de masas que se desarrolla en las Baleares a partir de los años 50. El resultado ha sido una desarticulación del modelo de organización territorial tradicional así como de la producción agraria que se basaba sobre las actividades agro-silvo-pastorales. En la actualidad aparecen nuevas actividades relacionadas con el ocio y la recreación, mientras que la apritud territorial de la Serra de Tramuntana en función de sus características se encamina básicamente hacia su transformación en un amplio parque natural.*

*RÉSUMÉ.- On analyse les changements de l'utilisation du sol dans la Serra de Tramuntana de l'Ile de Majorque (Iles Baléares, Espagne) provoqués par l'impact du tourisme de masse qui s'est développé aux Baléares à partir des années 1950. Le résultat est une désarticulation du modèle traditionnel d'organisation territoriale, ainsi que de la production agricole basée sur les activités agro-sylvo-pastorales. Actuellement, de nouvelles activités apparaissent liées aux loisirs et aux besoins récréatifs, tandis que l'aptitude territoriales de la Serra de Tramuntana d'après ses caractéristiques géo-écologiques s'oriente fondamentalement vers sa transformation en un vaste parc naturel.*

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**Key words:** *Agriculture, island, mountain, sustainable development.*

## 1. The Mallorca mountains

The mountain area of the Mallorca island is made up basically of two geomorphological and structural units with different territorial dimensions, represented, on the one hand, by the Serra de Tramuntana or Northern mountain range; and on the other, the Serres de Llevant (Mountain ranges of Llevant). Whilst the former constitutes a craggy mountainous region, the latter is made up of a group of hills with gentle, rounded slopes, with modest heights which never exceed 600 metres. Therefore the popular perception of the Mallorca mountain coincides with the Northern Mountain range or Serra de Tramuntana which has the real characteristics of mountainous areas. As a result we will only analyze the main characteristics of this latter morphostructural unit.

The Serra de Tramuntana covers an area of about 1.000 km² which represent almost a third of the territorial surface of the Mallorca island. This unit is basically made up of a strip of about ninety-eight kilometres long by an average of about fifteen km wide. Its morphology is uneven and with peculiar characteristics, especially noticeable in the carstic phenomena. It extends along the NW slope of the Mallorca island, from SW to NE. It is made up of a series of powerful carbonated masses —calcareous and dolomitic— inserted between marly or marly-calcareous type levels. On these lime materials fields of "lapiaz" have been sculptured, presenting a series of longitudinal valleys which have been excaved at the expenses of the marly levels. There are heights in this territory which exceed 1.000 metres (Puig Major: 1.443 m.; Massanella: 1.340 m.; L'Ofre: 1.090 m.; Tossals: 1.074 m.; Teix: 1.074 m.; Alfabia: 1.068 m.; Galatzó: 1.026 m.; Puig Roig: 1.003 m.). Morphological characteristics cause the rainfall on the Serra de Tramuntana to be greater than that of the rest of the island. The majority of the stations record 700 mm. and some even exceed 1.000 mm., and there is a moderate reduction in rainfall in any case from North to South and as the heights decrease. On the other hand the Serra de Tramuntana acts as a screen for certain climatic elements which attempt to cross it, thus affecting the orevall climate of the Mallorca island. Due to the climatic, geomorphological and edaphological features, and also because of the difficulty in reaching it, the Northern Mallorca mountain range comprises a rural space with a predominance of wide areas of natural or seminatural vegetation. This vegetation covers approximately 660 km², being made up basically of pines *(Pinus halepensis)* and holm oaks *(Quercus ilex)* which alternate with wide areas of scrub. The potential vegetation of Serra is defined by the alliances of *Quercion ilicis, Olea-Ceratonion, Rosmarino-Ericion* and *Teucrietum subspinosi.* The importance of each of these alliances on the space of the Mallorca mountain has undergone modifications, as a result of direct or indirect impact of the antropic action. The real holm oak *(Quercion ilicis)* is now practically non-



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existent, only being found on the shady slopes, which mand finds difficult to reach. In general, the holm oak is in a precarious situation, to which the action of animals, especially goats and pigs, has also contributed. This potential vegetation of the Serra de Tramuntana, which was dominant in times gone by, has been replaced by man's direct or indirect handling of the remaining alliances, which are those which make up the current natural landscape of the Serra.

The physical-ecological pecularities of the Serra de Tramuntana have meant that the cultivated lands record lower percentages than the other Mallorca regions. In general, they also register a recession with regards to earlier times, due to the fragility of a non-competitive agriculture which is only complemented with very extense cattle-raising and/or not very profitable forest exploitation. The Serra de Tramuntana has experienced important changes since the 50s and more especially since the 60s due to the impact of the mass tourism which takes place on the Mallorca island. This fact has caused the breakup of the traditional production economic model which was based on agriculture, resulting in diversification and a dependence on the service sector. The development of tertiary activities has had territorial consequences caused by the economic oportunities represented by tourism. This mutation experinced by the Mallorca mountains represents a differential fact with regard to the changes experinced by the mountain in general. The cause due to different processes. Whilst in the majority of the cases, especially in the peninsular mountains, these changes are motived by town developments and industrialization processes, in the case of Mallorca these transformations are based on the impact of a new activity being developped in industralized countries, related to the islands attraction for the people of Western Europe, led by tour-operators and charter flights, involving a massive influx of tourists to the Balearic islands. The elements of this decline are similar in all the mountain areas: Population decrease, aging, breakup of the traditional systems and changes in land-use. The agriculture in the mountain of the Mallorca island is, therefore, at crisis point. Its geographic marginality, its irregular morphology, the dominion of steep slopes, the typology of its climatic conditions and the lack of productive resources (soils with scarse agronomic quality, insufficient communications network...) have had a desisive effect. These already unfavourable characteriscs are becoming even worse due to of the profitability of the same crops in other parts of the island and even of the continent. Thus a double marginality occurs: Marginality within the island itself and marginality of the islands with respect to the continent. It must be highlighted however that apart from the purely economic profitability problems, the agricultural activities must be promoted due to geoecologial reasons. The protection of agricultural activity is decisive as it forms part of a complex system where the fragile agrosystems are submitted to a rapid environment degradation. To develop the mountain areas it is vital to maintain an agricultural system permitting the maintenance of the environment and the rural landscape with an interaction in the physical, biological, economic and social media.



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## 2. Land-use in traditional agriculture

The physical-natural elements which define the Mallorca Serra de Tramuntana have only permitted the existence of a fragile agriculture complemented by very extensive cattle-raising and a not very profitable forest exploitation. The climatic, lithological and edaphological characteristics have created a rural space where extensive areas of natural vegetation predominate, combined with wide sectors of rocky areas where cultivated lands are discontinuously inserted. This spatial organization has had peculiar implications in the Serra. The traditional and organizing element of this rural space has been the "possessió", term used in the Mallorca island for farms with a considerable acreage. This type of farm, defined by an integral use of the rural space, was the most decisive element in the human shaping of the agricultural landscape of the Mallorca mountain. Due to the geoecological characteristics of the Serra the "possessió" has, until recently, permitted an archaic agricultural structure whose essential features are determined by the predominance of a relatively large-sized property, owned mainly by people living in the insular capital of Palma, as well as by the maintenance of an archaic crop system which has kept this mountainous space on the fringe of agricultural innovations experienced by other areas of the Balearic islands. Thus the Serra de Tramuntana formed a monofunctional agricultural space which had hardly undergone any transformations until the arrival of the mass tourism in the 50s, since when it has progressively become a polifunctional space where relics of the old agricultural elements, such as the manor houses and centre of the farme, agricultural facilities and olive groves, coexist with new elements typical of an urban leasure society which has sought in the Serra de Tramuntana, spaces for its recreative and leisure expansion. At the time of the change which occurred in the fifties, the Balearic islands went from being a traditional agricultural society to being an urban society with a clear predominance of the service sector. What has led to this change has been the phenomenon of mass tourism which has had a significant effect on the insular space with explicit consequences on the traditional land-use and its function in the insular territory.

Until the fifties, agriculture and cattle-raising were the basic occupations of the Mallorca mountains. In this period the agricultural landscape of the Serra de Tramuntana was defined by two basic manifestations: On the one hand, a concentrated habitat, represented by a series of urban centres, whose active population was mainly agricultural; on the other, a scattered habitat appears represented by the "possessió". This exercised, until the beginning of this century, a direct predominance over the concentrated centres of population (SALVA, 1980) where a large mass of paid day labourers and farmworkers lived, depending almost exclusively on the "possessió's" labour demand at times of maximum agricultural activity ("seeding and cereal harvesting and olive collection). During the other seasons, they carried out a series of complementary tasks such as obtaining charcoal or



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felling trees (woodcutting), snow collecting (for town consumption) or else working in their very small plots of land (less than a half of hectare), located around the concentrated centres of populations, which were the result of a large property being divided into small plots, in order to maintain easy and nearby labour for the times of high demand (SALVA, 1978). This situation of absolute dominance of the "possessió" underwent the first changes between the beginning of the century and the fifties, before mass tourism began. In some sectors of the Serra the access of a relatively large number of small owners to small property is registered, due to the division into small plots of some large properties belonging to the Mallorca nobility. The nobility's control over the property began to break down during the last third of the XIX century by means of two different processes: a) Due to the integral sale of their farms, which led to a change in the territorial dominion in favour of the new Mallorca mercantile bourgeoisie; and b) due to the division of their farms into small farms. This last process coincides spatially with the more fertile lands located in the valleys and plains of areas such as Pollença, Selva, Alaró or Bunyola, resulting in the reappearance of the small properties which had only existed previously in the valleys of Andratx (SALVA, 1974) and Sóller, where even earlier there had been a large amount of small owners (SALVA, 1986). With this new situation, a new sector appears, independent of the "possessió", which sees how its role of absolute control over the mountain territorial organization decrease in importance.

These patterns define the geoecological characteristics of earlier times and the obvious result is a spatial organization of the land-use through agricultural farms based on weak dry farming, represented by non-profitable cereal crops in the form of self-supply; and by the olive, which occupied, in the middle of XIX century, almost half of the cultivated lands of the main Mallorca mountain (see table n.º 1). The oil obtained from the olive was, for centuries, one of the only commercial products and was even exported outside the Mallorca island. The cultivated land only represented a third of the territorial surface area. The rest was non-cultivated land of about 50.000 hectares of natural and/or seminatural vegetable covering, which was only used as fodder for extensive livestock rearing made up almost exclusively of sheep and to a lesser extent, by pigs. Occasionally the economy was completed with forest exploitation (tree felling) and the manufacture of charcoal based on holm oaks. The only exceptions were some sectors with market gardens (Sóller and Banyalbufar) which permitted the introduction of other more competitive crops (citrus fruits, vegetables). Man's action on this space of tradicional uses has has geocological consequences, especially for the original situation of natural covering of the Serra de Tramuntana. The anthropic action has affected the holm oak due to the impact of charcoal, on the reedbeds with continuous fires (to be able to use them for sheep pasture) and on the forest mass with the indiscriminate and irresponsible felling of trees without replanting them. Thus, soil breakup, vegetation cutting, fire and overgrazing are the main elements which have taken part in the current land-use situation of the Serra.



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TABLE 1

Agricultural land-use in the Serra de Tramuntana in 1860.

| *CROPS* | *EXTENSION* | |
|---|---|---|
| | *Ha.* | *% Agricultural Soil* |
| IRRIGATION | 907 | 2.61 |
| UNIRRIGATED LAND | | |
| Cereals | 8.472 | 24.40 |
| Olive | 18.355 | 52.86 |
| Almond | 803 | 2.31 |
| Carob tree | 4.587 | 13.21 |
| Others | 1.600 | 4.61 |
| TOTAL UNIRRIGATED | 33.817 | 97.39 |
| TOTAL CULTIVATED | 34.724 | 100.00 |

Source: SALVA (1978).

## 3. The current situation: types and trends in agricultural land-use

The appearance of new economic activities related to tourism has led to important changes in land-use in the Mallorca mountains with new geoecological consequences. The current economic coordenates of the Mallorca island present important changes with respect to the land-use of the Serra de Tramuntana and with regard to the pre-tourist territorial organization. These mutations are not only found in land-uses such as agriculture, livestock-rearing, town uses and/or others, with human implications, but also on natural or seminatural vegetation areas and/or non-productive areas.

The current land-use situation (see table 2) of the Mallorca mountain shows us a distribution where approximately 40 percent corresponds to forest masses, to which 28 percent corresponding to low mountain, must be added, resulting in a total surface area of 68% of the analyzed land being dedicated to natural vegetation areas and which represents one of the defining characteristics of the Serra de Tramuntana.

Farm lands are thus restricted to 24 percent with little more than 23,400 hectares. These surface areas which are the result of human action in earlier times, are now in decline and is represented by the progressive abandoning of the cultivated land. The land obtained with modifications in morphology and slopes through the creation of wide spaces dedicated to seeding (GRIMALT-BLÁZQUEZ, 1989), permitting the cultivation at heights of up to one thousand metres, now registers an abandonment process and an invasion of vegetation. These marginal lands, which were cultivated at times of great demographic pressure, are those which are now undergoing the worse abandonment processes.



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TABLE 2

Land use in the Serra de Tramuntana in 1988

| *CROPS* | *EXTENSION Ha.* | *% TOTAL TERRITORY* |
|---|---|---|
| *CULTIVATED SOIL* | | |
| Unirrigated without trees | 1.475 | |
| Unirrigated with trees | 19.350 | |
| Irrigation | 2.600 | |
| TOTAL | 23.425 | 23.86 |
| *URBAN SOIL* | | |
| Intensive | 4.450 | |
| Extensive | 3.225 | |
| TOTAL | 7.675 | 7.81 |
| *OTHER USES* | | |
| Extractive industries | 450 | |
| Reservoirs | 325 | |
| TOTAL | 775 | 0.79 |
| *NATURAL VEGETATION* | | |
| Pine grove | 24.250 | |
| Alzinar | 6.525 | |
| Alzinar-pine | 8.075 | |
| *Woods* | *38.850* | *39.59* |
| Low scrub | 5.370 | |
| High scrub | 22.050 | |
| *Scrubland* | *27.420* | *27.95* |
| TOTAL VEGETATION | 66.270 | 67.54 |
| TOTAL TERRITORY | 98.145 | 100.00 |

Sources: Data computed by the author, based on Agricultural census. Conselleria d'Agricultura and P.T.P. Serra de Tramuntana.

The comparative analysis of land-use evolution between 1860 and 1988 enables us to observe the recession experienced in the agricultural land of the Serra de Tramuntana, with a reduction of over 10.000 hectares. These cultivated lands have been taken up by different processes: a) on the one hand through the invasion of scrub and pines which involves a biological species substitution process due to human interventions; and b) on the other hand due to the process of change in land-use due to the large increase of land for town use. At present pines are consolidated as the most significant use, taking up a fourth of the Serra land and acting as a colonizing species of the majority of the remaining vegetal formations. Forest exploitation,



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which cannot be separated from the economic context was for centuries a complement to the Serra's agricultural activity. The forest areas which were used years ago as pasture for extensive livestock rearing, for hunting as an agricultural complement or to obtain charcoal and/or for supplying firewood for bakeries or for domestic consumption is only a residual activity nowadays. The introduction of energy sources based on oil and electricity have led to a decrease in the use of products such as coal and firewood. Today the forest's role is only important with regard to its conversion into hunting areas, related to town leisure, which is a very profitable activity for the owner of Serra farms and extends over more than 60.000 hectares, representing more than 60 percent of the mountain land.

The agricultural land-uses of the Serra de Tramuntana (see table n.º 3) are defined at present by the absolute predominance of the unirrigated land due to its edaphic, morphological and climatic features, from which it can be deduced that the Serra is not an area with an agricultural future. In this unirrigated crop system, the arboreal crops, among which the most significant are the olive, the carob tree and the almond, among other fruit trees, dominate. The dryland wooded crops coexist with land dedicated to cereal cultivation, usually in the lower areas. Among trees the most important is still the cultivation of olives due to its extension which has now been reduced to a series of steep slope areas, and with irregular plantations alternating trees of different ages, involving great differences in production between the different olive groves. Of over 18.000 hectares in 1860, today only about 9.500 hectares remain (40% of the cultivated surface area), of which only 6.700 ha. are claimed to be in cultivation. The olive groves now cover wide areas in the districts of Banyalbufar, Valldemossa, Deià, Sóller and Fornalutx,

TABLE 3

Agricultural land-use in the Serra de Tramuntana in 1988.

| *CROPS* | *EXTENSION* | |
|---|---|---|
| | *Ha.* | *% Cultivated* |
| IRRIGATION | 2.600 | 11.10 |
| UNIRRIGATED LAND | | |
| Cereals | 2.560 | 10.93 |
| Olive | 9.579 | 40.89 |
| Almond | 4.435 | 16.71 |
| Carob tree | 3.915 | 16.71 |
| Others | 336 | 1.44 |
| TOTAL | 20.825 | 89.90 |
| TOTAL AGRIC. SOIL | 23.425 | 100.00 |

Sources: Data from the author, *Conselleria Agricultura* and P.T.P. Serra de Tramuntana.



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where it appears as a dominant crop. The abandoned olive grove areas are taken up today by developments and/or were substituted for the almond and/or carob tree, especially in the meridional slope of the Serra.

The carob tree, well adapted to the Mediterranean basin, is the only crop which has been maintained, with certain ups and downs depending on the production demand related to the food industry. It is the transition crop between the olive and the almond which it is associated with in different areas, and now occupies the lands of the gentle and less fertile slopes, located in the meridional part of the Serra in contact with the region of Raiguer de Mallorca. As for the almond, which displaced the olive in earlier times from the plains and low valleys of the mountain range, it is also in recession related to commercialization and labour problems. Its presence is still intensive in the valleys of Andratx, Calvià and Pollença combined with cereals and/or carob trees.

Crops without trees are very dispersed, taking up bottoms of valleys, shelves of the mountain and/or carstic pits ("poljes") or dolinas. These cereals are used for grain and fodder, with long periods of fallow land, used as pasture. The cereals show a strong recession due to the abandoning of marginal extensions with decreasing yields, and were cultivated before within the self-supply system, being substituted now by reedbeds.

Finally, irrigated lands are only important in some very critical areas, being subject to factors related to water harnessing, a sheltered space and favourable edaphic conditions. Therefore the Serra has not had suitable space for irrigation, due to the soil conditions, but it has the advantage of having water in abundance. Because of this, irrigation is only used on 2.600 hectares representing approximately 2 percent of the total surface area, its presence is only outstanding in the valleys of Sóller and Follença and in the seeding areas of Banyalbufar, Estellencs and Deià. They are the only crops which offer greater profitability and make a more competitive agriculture possible; although in the Serra de Tramuntana they face problems related to difficulties in mechanization, the variability in the spring discharges and the search for crops which are more suitable for the urban and tourist demand. Only some sectors, such as the valley of Sóller and/or several pioneer farms in the production of fruit, meet this set of conditions, which permits, primarily, a market garden of about 250 hectares, with predominance of mainly citrus fruits. In the case of the stepped market gardens of the terraces of Deià, Estellecs and Banyalbufar, a decrease has been observed during the last few years related to it being transformed into secondary residence spaces and/or due to the abandoning of the cultivation. The remaining critical irrigation areas, such as the Saluet of the Port d'Andratx, the Pla de Peguera or the area of S'Albufereta de Pollença, have now been abandoned due to the effect of the urban expansion process of the nearby tourist areas.



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## 4. Current variables of the rural space of the Serra de Tramuntana: The future land use of the territory

In the previous sections the great changes which have occured in the rural space of the Serra de Tramuntana of the Mallorca island as regards agricultural land use have been seen. To these changes, we have to add other changes relative to depopulation processes, decline of the active agricultural population, demographic aging and the generalized abandoning of agricultural activities. The irruption of mass tourism involves a breakup of the traditional space and production organization model which had been maintained in the Serra until the fifties, causing a selective and concentrated rural exodus in groups of young adults, attracted by the demand for labour in the tourist and/or urban development areas of the Mallorca island. The crisis of the traditional and historic agricultural space means that new ideas must be thought up regarding the aptitudes of the Mallorca mountains, leading to an integral action of the use of the space of the Serra. There are many ways of using the space of the Serra at present, among which the most outstanding are recreational and leisure functions including the transformation into a great natural park, based not on a static philosophy but on a dynamic one, where a wide range of economic activities and the preservation of the ecological equilibirum can coexist. The problem is to find a process where the agricultural development is compatible with an integrated development based on the use of technologies able of developping with minimum interference to the environmental resources. In this aspect the protection of the agricultural activities is decisive, as the agrosystems are fragile and due to the abandonment process they are subject to a rapid environmental degradation. Given the main characteristics of the Serra, based on the preservation of an important natural coverage, a series of actions are imposed, directed at amortizing and eliminating the geoecological consequences of the anthropic actions.

Within this framework, different public and private entities and/or institutions have purchased of a series of farms, whose function is related to the preservation of nature and for non-lucrative ends. These are various farms purchased by the regional and/or insular administrations among which the public properties of Son Fortuny, Son Moragues, Els Tossals Verds, Son Macip, Manut-Binifaldó, Mortitx, Miner and Santuiri stand out, which in all group together about 5.000 hectares. To these we must add the communal goods owned by the municipality among which the communes of Bunyola, Fornalutx, Biniamar and Caimari stand out, among the most important ones.

## 5. Conclusions

The spatial organization of the Serra de Tramuntana of the Mallorca island has undergone heavy changes reflected on the one hand in a change of



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land-uses and on the other by a land marginalization process which affect the spatial organization. If we consider the Serra's territorial organization model as a complex system where the social organization subsystems, the technological mechanisms and the environmental subsystem are interrelated, any marginalising of a subsystem implies fuctuations on the overall system. From this starting point the current situation of the Serra de Tramuntana is defined by a series of conflictive situations which affect its vocational aptitude. The geoecological consequences of these conflicts are focused basically on the impact from three fronts which place pressure on the territory: grazing, fires and human action. The human actions and grazing involve a decrease of the groves (absence of groves and aging of the arboreal elements), whilst the fires lead to the colonization of great spaces by species which in spite of fixing the substratum, do not lead to a progressive evolution of the vegetation. The abundance of pines and scrub in the areas abandoned by agriculture considerably increases the risk of forest fires. On the other hand farmland abandonment and its generalized deterioration as well as the surface areas which have recently undergone deforestation processes, destruction of the plant cover and/or pre-existent agricultural soil, due to the growth of the urban soil through intensive and/or extensive town development, register serious erosion processes, causing an increase of the flooding because in the runoffs associated with the disappearance of the vegetation that retained the water before.

The crisis of the rural space of the Serra de Tramuntana means that a series of dynamic perspectives regarding to its vocational aptitudes have to be established. Within this framework a rational organization of the leisure spaces is imposed, both for occasional recreational activities (weekends) and for secondary residences, the transformation of the Serra into a large natural park and the protection of the territory faced with the threat of it being transformed into urban estates. Within the framework of agricultural uses, alternatives are imposed with respect to optimum profitability. An agricultural policy is necessary in order to maintain agricultural activities and crops with an ecological and lancscape objective; this involves, on the one hand, a commercialization policy of the traditional products, and on the other, a promotion of complementary activities for the farmer, such as agrotourism, rural tourism and/or ecological tourism, among others.

If we consider the territory of the Serra de Tramuntana of the Mallorca island as a complex system, integral action must be taken where the subsystems related to the environmental characteristics, the aptidudes of the territory and the social-economic possibilites of the resident population are taken into account. The Serra de Tramuntana can thus maintain a sustained development with minimum anti-ecological interferences, eliminating the impact imposed by urban and tourist processes which define the current society of the Balearic islands.



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